

Do Manitoba Growers Need to Apply Manganese to Soybeans?

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Background

Manitoba growers are questioning the need for manganese (Mn) when growing soybeans because:

- US reports of Mn deficiency symptoms with glyphosate –resistant cultivars treated with glyphosate¹
- Deficiencies are associated with soils low Mn, high organic matter (OM), high pH and low moisture levels.
- Visual deficiency symptoms are very similar to iron chlorosis deficiency which is common in Manitoba soils (Figures 1-2)

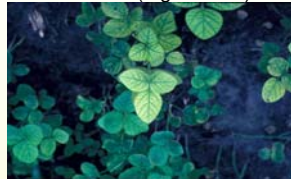


Figure 1. Typical Manganese Symptoms in Soybeans (Photo - OMAF)

Figure 2. Manganese deficiency symptoms are similar to symptoms of iron chlorosis in soybeans. (Photo D. Mengel, K-State)

Previous MB studies of soybeans indicate that rather small amounts of Mn are taken up and removed in the crop² (Figure 3)

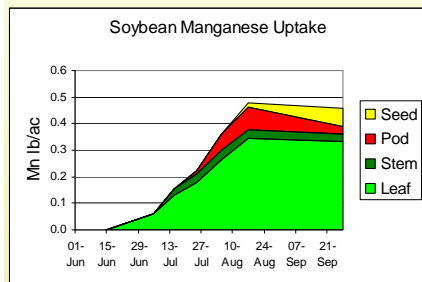


Figure 3. Manganese uptake pattern by a 45 bu/ac MBN soybean crop (Heard, 2006)

Method

Three sites were selected – Carman, Rosebank and Ste Adolphe.

Sites were soil sampled and 3 Roundup Ready cultivars seeded: LS 0036, 24-52 R and NSC Portage RR. Soybeans were seeded in narrow rows, fertilized and inoculated according to recommendations. The production timetable is seen in Table 1.

The study was established as a factorial design replicated 3 times with Mn treatments as main plots and cultivar as sub-plots.

Soybeans were sprayed with glyphosate herbicide (Roundup Weathermax) at 0.67L/acre with 0.25v/v LI 700 surfactant in 100L/ha water. The treated plots included Mn fertilizer (Nortrace Citraplex 22% Mn) at 1 lb/acre.

The top fully developed leaf was sampled prior and after foliar treatment. Leaf chlorophyll was determined with the SPAD chlorophyll meter in early August (Figure 4). Data was analysed using ANOVA.



Figure 4. Chlorophyll readings in August.

Table 1. Study site description, production details and measurement schedules.

Sites	Carman	Rosebank	Ste Adolphe
Soil type	Winkler clay loam	Reinfeld loam	Scanterbury clay
Soil Mn	11.1 ppm	12.1 ppm	10.2 ppm
Soil pH	7.0	6.4	6.3
Soil OM	5.4%		7.5%
Seeding Date	May 21	May 27	May 28
Foliar application	June 30	June 30	July 5
SPAD reading	Aug 5	Aug 5	Not done
Tissue test dates			
Pre-spray	June 30	June 30	July 3
Post-spray	July 8	July 10	July 16
Harvest Date	Oct 21	Oct 22	Oct 24

Results

Soil Mn at all sites exceeded the critical level of 1.0 ppm (Table 1) and moisture was not limiting in the 2009 season. Application of Mn increased tissue Mn at 2 locations – however all levels exceeded the published critical levels of 20 ppm (Fig 5). Chlorophyll content was not influenced by Mn treatment (Fig 6) but varied by cultivar (Fig 7).

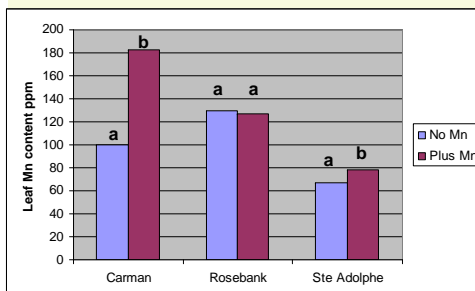


Figure 5. Leaf Mn concentration after application (averaged across cultivars). Bars under the same letter are not significantly different at the 5% level.

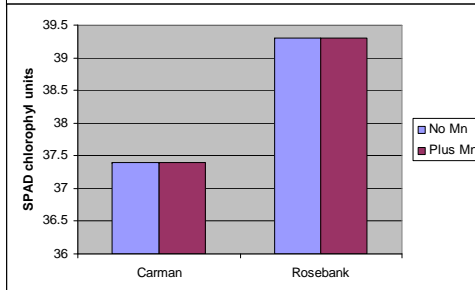


Figure 6. Effect of Mn treatment on leaf chlorophyll values (averaged across cultivars).

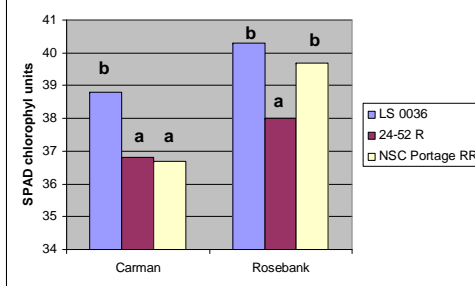


Figure 7. Effect of cultivar on leaf chlorophyll values (averaged across Mn treatment). Bars under the same letter are not significantly different at the 5% level.

Manganese did not affect yields at Carman and Ste Adolphe, but significantly increased yields at Rosebank by 4.4 bu/ac (Figure 8). Yields also varied by location and cultivar (Figure 9). There were no interactions between Mn application and cultivar.

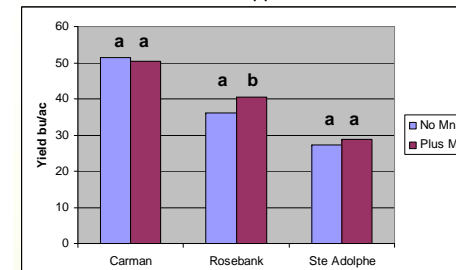


Figure 8. Effect of Mn treatment on soybean yield (averaged across cultivars) Bars under the same letter are not significantly different at the 5% level.

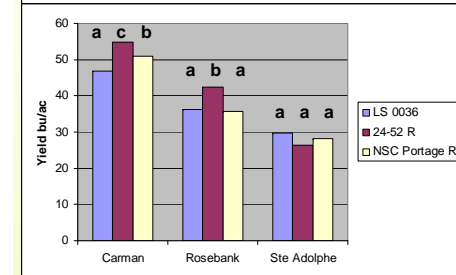


Figure 9. Effect of cultivar on soybean yield (averaged across Mn treatment) Bars under the same letter are not significantly different at the 5% level.

Discussion

Growth and yield response to Mn was not expected based on the very high soil and tissue levels and presence of moist spring soils. Similarly there were no treatment differences in chlorophyll content or visual appearance (Figure 1). The lack of any yield effect at Carman and Ste Adolphe was expected. However the significant yield response at Rosebank is surprising, especially since applied Mn did not increase tissue levels. The yield response was consistent across all 3 cultivars and there was no interaction.



Figure 10. Soybean growth at Rosebank location.

Summary

Yields responded positively to manganese fertilization with glyphosate in 1 of 3 locations in 2009. This response was unexpected and was not predictable based upon very high soil and leaf Mn levels. Further research may be required to determine the consistency of this response and whether current soil and tissue critical levels are appropriate for soybeans.

References

- Gordon, B. 2007. Manganese nutrition of glyphosate-resistant and conventional soybeans. Better Crop/Vol. 91 No.4 <http://www.ipni.net/ppiweb/bcrops.nsf/googleIndex/70ABDB50A75463F085257394001B157F?file/07-4p12.pdf>
- Heard, J. 2006. Nutrient uptake and partitioning by soybeans in Manitoba. http://www.umanitoba.ca/afs/agronomists_conf/proceedings/2006/heard_nutrient_uptake_and%20partitioning.pdf